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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Reflections on the Congress.

One of the striking features of the Paris Congress was the number of joint or collective exhibits. Out of a total of something over three hundred exhibitors, nearly one-half were to be found in these group exhibits. Fortunately, they were in every case almost wholly confined to cast products, as otherwise they might seriously have cut across the basic grouping into raw materials, cast products, equipment, education and technical progress, etc. We have previously drawn attention to this tendency to grouping and recognise the difficulties of the situation. Many exhibitors do not wish to embark on the trouble or expense of a special stand, and probably would not show at all if a group exhibit were not encouraged. At the same time, such an exhibit is less satisfactory to the visitor. A group exhibit tends to lay stress on the similarities between products grouped, whereas the visitor is more concerned with their differences, which come out most strongly when exhibits are frankly competitive. Grouping for exhibits of castings is satisfactory, but we should regret any tendency for it to spread to equipment, supplies and raw materials. Some of the groups at Paris were based on the product (*e.g.*, malleable iron) and some were national (Italy, Belgium, Spain), while others were of regional French associations of founders.

Another reflection is that the Exhibition was a world exhibition, at which participation of all the countries concerned was invited and hoped for. Britain and America were wholly unrepresented, and, broadly speaking, Belgian, Italian and Spanish participation was confined to the group exhibits, although the inducement for makers of castings to participate is surely less than that of makers of equipment and supplies. If the countries participating cannot ensure the participation of all concerned in a world exhibition, the distinction between a world exhibition and an international exhibition becomes a distinction without a difference. The question, indeed, arises whether the industry is large enough and well enough off to support an annual exhibition with a world exhibition every three years. One is bound to admit that the outstanding novelties at Paris were few, and this was equally true of Milan. Would not the interests of all be better served by mutual agreement on a less ambitious programme? The present situation is certainly not one that can be allowed to remain indefinitely, and we feel sure that the Committee will keep this consideration in mind. A trade revival, of course, would make all the difference to the situation, in which case the agreed plans would be practicable and workable, and indeed, welcomed, by all concerned.

Coal-Dust Bonded Sand.

The whole of the grey-iron foundry industry will join with us in congratulating Mr. Ben Hird on his researches into the influence of coal dust on moulding sands which is printed elsewhere in this issue. His figure number 5 is particularly illuminating as showing that amongst the sand in an area not far removed from that in contact with the molten metal, the coal dust is coked and consequently evolves gas and tar-oils. The latter coat the grains of sand in the outer portions of the mould and institute a bond utilisable in subsequent casts. In isolated cases, tar-oils have been used as a bonding medium for moulding sands. But what has not been tried? This excellent piece of work suffers in respect to the final nomenclature used, that is, "carbon" bonded. These sands are not "carbon" bonded but "tar-oil" bonded. Now we can understand that Mr. Hird did not wish to use this phrase, as no doubt he desired to distinguish between his *induced* tar-oil bond and the *added* tar-oil bond to which we have referred. They were not comparable owing to the great difference in the method of its dissemination throughout the mass of the sand. Now, as Mr. Hird's tar-oil bond is derived from coal dust, we suggest that it would have been preferable to retain this word and call it "*coal-dust*" bond. After all, it is more nearly technically correct than "carbon" bond. "Coal-dust tar-oil" bond, whilst unimpeachable as a correct designation, is too long an appellation.

Now that the nature of this bond has been established, it still remains to be seen whether moulding sand would be improved or deteriorated by the presence or absence of the residual coke. We think it would be interesting nearly to fill a horizontal rotating cylinder with clay-free sand and slowly to pass through the cylinder the products resulting from the cokeification of bituminous coal or perhaps the distillation of tar oil. This experiment would be comparatively easy for steel and other foundries possessing rotary drying kilns for sea sand. The more one examines this work of Mr. Hird's the more interesting it becomes as a basis for experiment. For instance, does it reveal a method for the reclamation of burnt oil-sand cores? Once more we offer hearty congratulations to Mr. Hird on the excellence of his research results.

Fourth International Foundry Congress.

This congress, held under the presidency of Monsieur Eugene Ronceray, the chairman of the Association Technique de Fonderie, was held in Paris from September 13 to 18. It was under the patronage of the President of the Republic, the majority of the Cabinet, and all the leading industrial figure heads of France.

The attendance suffered considerably owing to the present unsatisfactory state of world trade. As usual it was accompanied by an exhibition, and a description of this will form the subject of a separate article.

The British party, headed by Mr. Andrew Harley, left Victoria on Tuesday, September 13. They were welcomed at the Gare du Nord by Mr. Ronceray. In the evening, at 9 o'clock, the visitors attended a reception and an informal dance at the rooms of the Arts et Métiers Old Students' Association. Here an opportunity was given to renew old friendships and what the Americans call "get acquainted." On Wednesday morning at 9 a.m. the congress opened at the Sorbonne, and speeches of welcome and appreciation were made by Mr. Ronceray, the President; Mr. Andrew Harley, the President of the Foundrymen's International Committee; Mr. de Freminville, President of the National Committee of the French Organisation; Mr. Dufour, President of the French Foundry Employers' Federation, and the Under-Secretary of State for Technical Education. After a Paper on "Safety First" by Mr. Ageron, an excellent film showing the shops of the Paris-Orleans Railway Company and the methods they use for their organisation. Mr. Bloch, who used this to illustrate his Paper, is to be congratulated on the excellence of the production.

In the afternoon the exhibition was visited. Centrally situated was the stand of the Paris Foundry Higher Grade School, and from 3.30 to 7 o'clock a series of Papers was presented. This meant that all the jar-ramming machines had to stop working, but such a heavy programme had been prepared there was no alternative. At 5.10 the members were taken to Ecole Nationale d'Arts et Métiers for a reception by the Under-Secretary for Technical Education.

On Thursday morning the visitors were on parade at 8 o'clock to visit either the Renaud factory or Vitry Steel Works and Bonvillain & Ronceray's foundry-equipment works. Over 100 went to the automobile works and were first taken through aluminium and bronze foundries. Here continuous casting was being carried out. Instead of a sand conveyor for serving the moulding machines there were overhead gangways, and by means of wheelbarrows a constant supply of sand was maintained. Steel and malleable founding were housed in the same shop. For preparing the former the baby Bessemer process was used, and for the latter a coal-fired air furnace. In this shop but little attempt at mechanisation had been attempted, and considerable use of overhead cranes was made. These are still driven by female labour, whilst the majority of the unskilled and semi-skilled workmen were foreigners. Only the foremen and highly-skilled operatives were French. In the cylinder shop we noticed that for the assembly of the cores use was being made of solder. The various cores had registering perforations, which, when filled with solidified solder, formed what is virtually a rod for assuring rigidity. It was at this point that we found ourselves in conversation with Sir George Cahil, the Commercial Adviser to the Paris Embassy. His interest in the congress was both sincere and profound, and his close collaboration in such matters is well worth emulation by his colleagues under similar conditions. In this shop the slag from the cupolas ran into a stream of water for granulation purposes. The production of cylinders was prodigious. Three men working two machines were turning out between four and five moulds a minute. The labourer worked first with one operator and then with the other, changing his mate every 5 min. or so.

In the afternoon, at the Arts et Métiers School, three simultaneous sessions were held, covering cast-iron, non-ferrous and light alloys, fifteen Papers being disposed of. After spending half-an-hour inspecting the workshops and laboratories of the school, the visitors went to the City Hall for a reception by the Mayor of Paris. After two short speeches by His Worship and Mr. Ronceray, light refreshments were offered, and the magnificently decorated halls were inspected and admired. Dinner was taken on the first floor of the Eiffel Tower. This was followed by an informal dance until midnight.

Mr. E. V. Ronceray.

The President of the International Foundry Congress. He is also President of the Association Technique de Fonderie, and is chairman of the board of directors of Messrs. Bonvillain et Ronceray, of Choisy le Roi, near Paris, and its British subsidiary company, Universal System of Machine Moulding & Machinery Company, Limited, of London, manufacturers of foundry equipment. As chairman of the literary committee of the French association, he has been responsible for procuring of technical Papers, both for national and international presentation to the various foundry organisations. His complete mastery of the English language makes him an ideal liaison officer when international matters are being discussed. He is an honorary member of the Institute of British Foundrymen and holds membership in the Iron and Steel Institute and the American Foundrymen's Association.

On Friday once more the rendezvous was at 8 o'clock for visiting either Citroën & Lobstein or the Compagnie des Compteurs. We elected to re-visit Citroën. It is an excellently laid-out works, but, if we could offer a suggestion, we would advocate the extension of the use of roller conveyors, as there seemed to be too great a tendency to fill and empty boxes lying on the floor level. Multiple moulding was used for piston rings, the metal being melted in Detroit rocking furnaces. In the afternoon, a matter of 23 more Papers were disposed of in four simultaneous sessions and one plenary one. These dealt with questions of general interest—malleable iron and steel, diverse subjects, and testing cast iron. At 4.30 the whole Congress moved from the Arts et Métiers to the Institute of Civil Engineers, where three more Papers were presented.

On Saturday a second visit was paid to the Exhibition, and three more Papers were squeezed in, using the small tent-like structure around the stand of the Foundry Higher Grade School. In the afternoon the Congress assembled in the Hall of the Comité des Forges (the French Ironmasters' Association) to hear three more Papers read, and to listen to the final speeches made by Mr. Ronceray and Mr. Luc, a State official controlling technical education.

Closing Banquet.

The conference banquet was held at the Palais d'Orsay Hotel, under the presidency of the Under-Secretary of State for Technical Education. The high table included Sir George Cahil, the Commercial Adviser to the Paris Embassy, and Mr. Andrew Harley. The remainder were mainly the representatives of the Cabinet Ministers and the officials of the organising bodies. We were pleased to see that Sir Henry Fowler, the President of the Institute of Metals, had come over specially for this function. The first speech was by Mr. Ronceray, who, following French custom, took the opportunity of thanking almost individually all who had helped him with the organisation of the congress. He was followed by Mr. Harley, who, as President of the Foundrymen's International Technical Committee, replied on behalf of the guests. In the course of his remarks, Mr. Harley said he felt highly honoured to have this opportunity of addressing the meeting as President of the International Committee of Foundry Technical Associations. It was worthy of mention that his predecessor in this position, Mr. Damour, was a distinguished Past-President of the Association Technique de Fonderie. During this congress we have met under the sense of loss which the whole foundry industry has sustained in the recent death of another Past-President of the International Committee, Mr. Vanzetti. It is only a year ago that many of you were in Italy attending the wonderful congress which Mr. Vanzetti organised, and to which he gave so much devoted work. On behalf of the associations represented on the International Committee and on behalf of all the members of the congress and the ladies, it was his very pleasant duty to express to the President (Mr. Ronceray) and to the Association Technique de Fonderie their sincere thanks for the wonderful time they had had in Paris during the last few days; furthermore, they wished to congratulate him very sincerely upon the great success of this World Foundry Congress and Exhibition.

The visitors had had an opportunity of visiting many foundries in the region of Paris and had seen the high degree of efficiency which has been attained. An opportunity was being given of inspecting foundries in other districts and, no doubt, many would take advantage of this privilege.

The programme of Papers presented at the Congress has been comprehensive and has covered almost every topic of importance connected with the foundry. Scientists and technicians have shown that their researches have been systematically directed towards the solution of foundry problems, and the information given should enable everybody to improve the quality of their castings. Many of the Papers have been very practical in character, and authors have proved the importance of applying the scientific data at our disposal in an intelligent manner.

The foundry trade had developed rapidly during the last few years, and there was still ample room for improvement. Modern research was playing an important part, not only in elucidating the basic principles which governed the production of good castings, but also in discovering new alloys which could be applied to a wider range of industrial uses.

He emphasised the great importance of an international gathering such as this in promoting the welfare of the foundry industry. It

provided a medium for the exchange of ideas between the foundrymen of various countries. It was a curious fact that for all the finest things in life there were no national boundaries. One could enjoy each other's music, literature, and even share in the results of scientific research. In other words, the great things of the mind and spirit can soar above petty political considerations, and he felt sure that the same ideals would solve the more domestic problems also.

The city of Paris has always taken a prominent part in the promotion of technical education, and it is fitting that one of the first schools devoted to the study of foundry practice in the world should be established in this city. He congratulated the President on the great success which was maintained by this school—success which was largely due to his own efforts and to his distinguished leadership as director.

Some of them had been discussing earlier that day a scheme for the exchange of selected foundry students between the various countries represented on the International Committee. He felt that a determined effort should be made in that direction. It was no doubt difficult for people getting on in years to discard their prejudices. In his view, the essence of real international friendliness lies with the young people, and every encouragement should be given not only for them to spend their holidays in other countries than their own, but also to spend a year or two of their industrial training as well. It would be a great achievement if the International Committee could start such a movement on however modest a scale.

On behalf of the visitors, he expressed their warm appreciation of the social gatherings which they had been privileged to attend, and he tended their thanks to the city of Paris for according them such a splendid reception. He again thanked the President and his colleagues for all that had been done for their entertainment, and he was sure that everyone would take away very happy memories of their visit.

The Foundry Exhibition was a wonderful indication of the very high degree of efficiency which the industry had achieved. Many nations had contributed to this great enterprise, and they were full of admiration at what they had seen during the last few days. Some of them, at any rate, could appreciate the amount of work which had been necessary in organising this great undertaking, but it must be clear to all that this work has been carried out in a very able manner.

After one or two more speeches, it was announced that a new gold medal had been created bearing the name of Mr. Damour, and the first recipient was Mr. Emile Ramas, a Past-President of the French Technical Association. Judging from the cheering with which this announcement was greeted, no more popular choice could have been made. The banquet was followed by dancing until the early hours of the morning.

On Sunday the members left Paris for Rambouillet, where they were received by the President of the Republic. On Monday the majority made the return journey to London, a little tired, but still delighted with their trip in France.

Domestic Heating.—Messrs. John Wright & Company, Essex Works, Birmingham, a constituent member of the Radiation group, has sent us their new Winter's lists, which deal with "Classic" fires; Console cabinet radiator and hoops of heat gas radiators. As we are inexperienced in reviewing material meant for the general public, we asked the opinion of our colleague, the Editor of the "Advertising World," and his comment was they were a really excellent production conforming to all that is best in modern publicity matter.

District Presidents.—No. 7.

MIDDLESBROUGH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

Mr. Sidney P. Thorpe, the President of the Middlesbrough Branch of the Institute, has served the whole of his foundry career in the employ of Messrs. Chas. P. Kinnell & Company,

Mr. Sidney P. Thorpe.

Chairman of the Middlesbrough Branch of the Institute of British Foundrymen.

Limited, heating engineers, of London and Thornaby-on-Tees, and he has been no less than 20 years on that firm's staff. When Mr. Thorpe first joined the firm he was attached to its headquarters in London and remained there for the ensuing two years.

In 1914 he enlisted and spent the next five years on the "Western Front." On his return in 1920 he was transferred from London to Thornaby-on-Tees, where he has remained to this day, and now holds the position of foundry manager.

Mr. Thorpe has been a member of the Institute of British Foundrymen since the inception of the Middlesbrough Branch in 1926.

The Building Trades Exhibition.

The Exhibition, which has been running at Olympia during the last fortnight, serves to impress upon one the importance of the foundry industry to the building trades. About 5 per cent. of the exhibitors were foundry owners, and the products shown ranged from a man-hole cover to beautiful art castings carried out in bronze. If we sense public opinion aright, there will be an increased demand for art castings in the near future. We think the man in the street is just a little tired of bright steel and scarlet. For woodworking machinery this exhibition compares very favourably with any other, except, of course, that the machines chosen for exhibit are those primarily of interest to the carpenter, and not the patternmaker. We were pleased to notice the great progress that is being made in enamelling and colouring aluminium ware. After spending an afternoon at Olympia, we were satisfied that exhibitions when organised by experienced private enterprise are probably more interesting and better run than by semi-governmental efforts.

Publication Received.

Specifications and Methods of Test for Refractory Materials and Manual for Interpretation of Refractory Test Data. Published by the American Society for Testing Materials, 1315, Spruce Street, Philadelphia, Pa., U.S.A. Price 50 cents.

This publication brings together in convenient form the several A.S.T.M. standard specifications, methods of test and definitions pertaining to refractories. Standard specifications are given for clay firebrick for (1) malleable furnaces, (2) stationary boiler service and (3) marine boiler service. Methods of testing are given (1) for refractory brick, (2) for refractory materials under load at high temperatures, (3) for porosity and permanent volume changes in refractory materials, (4) for softening point of fire-clay brick and (5) for chemical analysis of refractory materials, including chrome ores and chrome brick. Also included are tentative test methods (1) for the resistance of fire-clay brick to thermal spalling and (2) for determining the particle size of ground refractory materials. Standard definitions include clay refractories, terms relating to refractories and to heat transmission of refractories.

The Manual for Interpretation of Refractory Test Data, which is included, was prepared by Committee C—8 on Refractories. It is felt that the desired effectiveness in the use of refractory tests in the control of manufacture, inspection and utilisation of refractories cannot be attained until test procedures and methods of reporting data are on a sound statistical basis. The Manual is an important step in this direction. Some of the more important phases of this subject which are discussed are as follow:—Importance of sampling and methods of reporting data, analysing data from one sample for inspection purposes, analysing data from one sample for scientific purposes, interpretation of data from one sample, interpretation of data from several samples and selection of samples.

New Members of the Iron and Steel Institute.

The following is a list of the names of the candidates proposed and elected as members of the Iron and Steel Institute at the autumn meeting:—

Proposed as Members.

Bleloch, William, Transvaal, South Africa, chief chemist; Clayton, Gerald Charles, Surbiton, furnace engineer; Heggie, Richard Graeme, Johannesburg, South Africa, chemical engineer; Jenkin, John Watson, Birmingham, metallurgist; Kerl, Ernst, Pretoria, South Africa, steelworks manager; Michael, Richard Gerald, Swansea, works manager; Orme, Fred, Sheffield, lecturer in metallurgy; Otto, Charles Augustus, Manchester, technical editor; Pavord, Vincent Dwelly, Leicester, chief inspector, metallurgist and heat-treatment engineer; Rabbitt, James A., Tokyo, Japan, consulting engineer; Steedman, Alec Hay, Weybridge, manager; Thomas, Oswald James, Pontardulais, Swansea, metallurgist.

Proposed as Associate.

Fearnehough, Robert Carlton, Sheffield, research assistant.

Economic Situation in Finland in July.—The Department of Overseas Trade has published a Report on the Economic Situation in Finland in July, 1932, prepared by the Commercial Secretary to the British Legation at Helsingfors. Ref. No. C.3,969.

The Foundries of Craven Brothers (Manchester), Limited.

There are several foundries in Great Britain which come well within the category of "national" importance; few, however, can claim this appellation with more certainty of general acceptation than the foundry of Messrs. Craven Brothers (Manchester), Limited, Vauxhall Works, Reddish, Stockport. This is not merely on account of the great facilities they possess for making the largest variety of machine-tool castings, but the accumulated knowledge and experience which allows the management to count such work as routine jobs. Before inspecting the foundry, we toured the machine shops with Mr. R. Greenwood, the managing director, and saw some of the largest planer-bed castings ever made being machined. Here were castings which, judged by normal standards, should be masses of open-grained, porous metal, were as sound and dense, yet easily machinable as one associates with heavy sections, and naturally we looked forward with pleasure to an inspection of the foundry capable of producing such excellent results.

FIG. 1.—GENERAL OFFICES, MESSRS. CRAVEN BROS., LIMITED.

Drawing Office and Pattern Shops.

As castings are born in the drawing office, it is just as well that they should be brought into the world under as near ideal conditions as possible, and Fig. 6 illustrates what is undoubtedly one of the finest in Great Britain. The lighting and ventilation are excellent, whilst the fullest co-operation is maintained between it, the pattern shop and the foundry.

As will be seen from the lay-out of the foundry buildings (Fig. 2), there are virtually two pattern shops. The narrower one is reserved for apprentice training and is shown in Fig. 3. Fig. 4 illustrates the ground floor of the men's shop, which is particularly well equipped. For handling really heavy patterns, there is a 5-ton overhead electric crane, which is not a luxury when one sees the heavy nature of the castings currently manufactured. Outstanding amongst the equipment in this shop is a Wadkin Universal woodworker, shown in Fig. 5; three jacking machines; a large planer; two double-sided sanders; two band saws; two dimensioning saws; two parring machines; and two lathes. In addition to this there is a full complement of tools in the timber section, such as a 3-ft. dia. circular saw, lathes, grinders for saws and planing-machine blades. In short, no money has been spared to provide the men with every aid mechanical science can give them.

Iron Foundries.

Jobbing foundries can be mechanised only to a very limited extent, as every job, or at least every range of jobs, is a law unto itself, and the average foundry manager would not appreciate an overhead supply of a hundred tons of system sand. What he does appreciate is undoubtedly a full range of reliable heavy-duty, steady-lifting overhead electric cranes. In this respect the Craven heavy and light foundries are splendidly served. In the heavy bay there are four 25-ton and two 10-ton capacity cranes of their own manufacture, supplemented by a 2-ton wall crane. Two 10-ton electric cranes span the light foundry and a 1-ton the light core shop. The size of the foundries can be gauged by the fact that their area

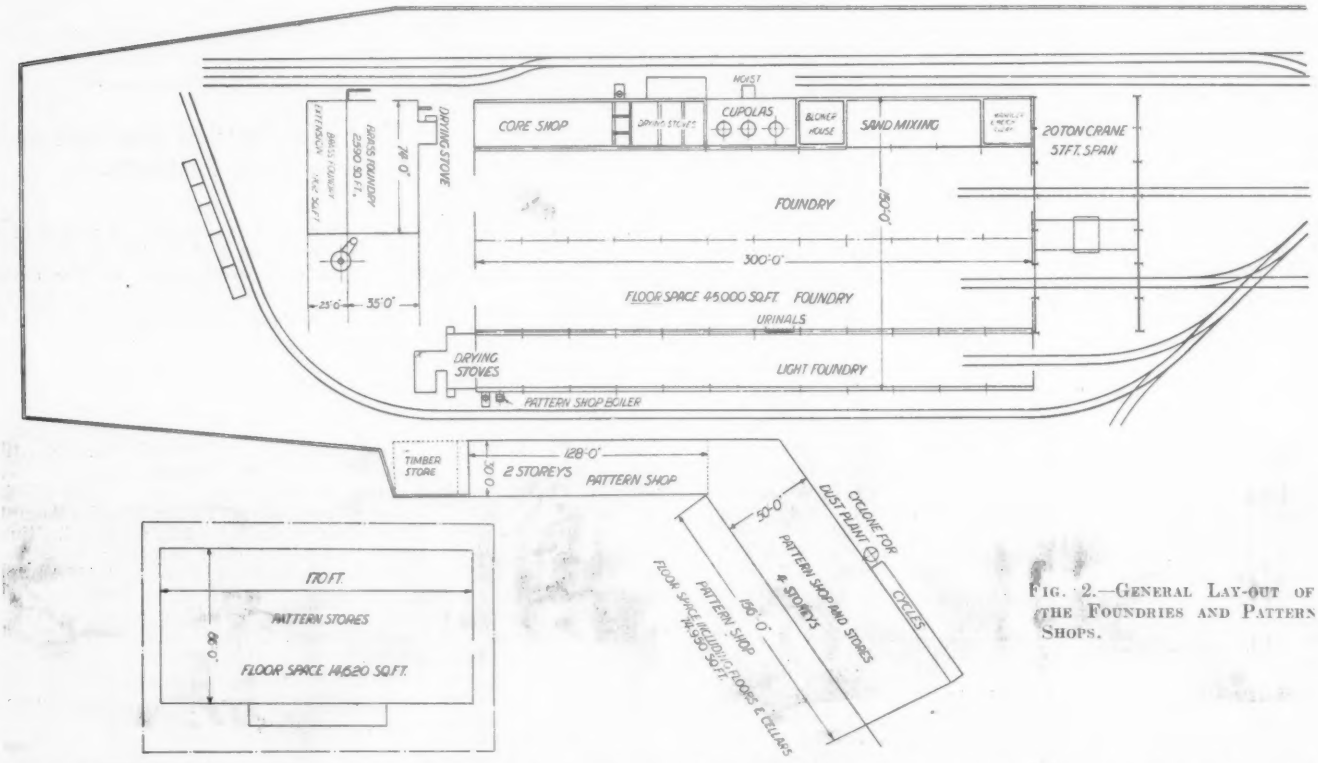

FIG. 2.—GENERAL LAY-OUT OF THE FOUNDRIES AND PATTERN SHOPS.

Fig. 3.—This Pattern Shop is reserved for the Training of Apprentices.

is in the neighbourhood of 45,000 sq. ft. A useful prerequisite of the heavy jobbing is the provision of adequate mould and core-drying plant. This work has been entrusted to August's, Limited, who have furnished three large stoves each 25 ft. in length, 13 ft. in height and 15, 13 and 11 ft. in width respectively. The light foundry also has three stoves all 20 ft. long and 10 ft. high, but two of them are 6 ft. wide, whilst the third is 13 ft. 6 in. This plant is supplemented by eight portable coke-fired, air-blast-driven stoves of Belgian design, whilst portable oil stoves are used for skin-drying. Much work is bedded in the floor, and no less than 12 properly-prepared pits are available. They range from 4 ft. by 12 ft. by 4 ft. deep to 14 ft. by 40 ft. by 8 ft. deep and are constantly in use for making bedplates, headstocks, uprights, etc. There is one still deeper pit, 12 ft. square by 20 ft. deep, which is used for drums, liners, hydraulic cylinders and spindles. Such pits can obviously take care of castings weighing 40 tons and over.

Sand Preparation and Milling.

A plant designed to give batch mixes and present a maximum of elasticity is the ideal requirement of a heavy jobbing foundry. The management have assured this by installing a pair of August-Simpson machines, shown in Fig. 7. They are automatically loaded and discharged into portable wheeled boxes for ready transport to the moulding sites. Before treating in this plant it is usual to effect a rough mixing

Fig. 4.—The Ground Floor of the Men's Pattern Shop.

Fig. 5.—A Wadkin Universal Woodworker is Installed.

Fig. 6.—The Drawing Office has Accommodation for 60 Draughtsmen.

Fig. 7.—August-Simpson Mills discharge in Small Trucks for Transport to the Moulders.

in a pan mill by Brearley. The department is placed adjacent to the sidings for the easy reception of new sand. For dressing the sand on site a Pneulec-Royer is used.

Raw materials for melting enter the yard from sidings connected with the London Midland & Scottish Railway, and are stocked near the cupola stage. After weighing they are taken to the stage by an electrically-operated hoist and hand-charged into the cupolas, of which there are three. Two are rated at 8 tons an hour and one at 4½. For emergency and experimental work, recourse is had to a cupolette, and the ladle plant has been chosen to give as wide a combination as possible, and their capacities are stepped down from 20 tons in easy stages to 15 cwts.

Whilst good equipment of ample capacity makes for economic production, it will not guarantee good castings. The underlying principle at Craven's foundry is primarily to treat each member of casting in the light of its subsequent service in industry and then to consider the casting as a whole, and to legislate for its over-all strength and soundness. Thus, a part of a casting may possess a wearing and sliding surface, and according to its cross-sectional thickness, so it will be densened quite massively, or accelerated cooling may be achieved by the insertion in the sand of a quantity of evenly-spaced 1½-in. dia. cores. An intensive study has been made of the nature and control of camber, the results of which were published in the form of a Paper by Mr. E. Longden, the foundry manager, to the recent Newcastle Conference of the Institute of British Foundrymen and printed in our issues of June 30 and July 7. Such experimental work as was disclosed by that thesis naturally demands testing equipment of a high order, and the foundry is fortunate in possessing well-equipped chemical, physical and mechanical laboratories.

machines, which at the time of our visit were engaged upon the production of gear blanks and rings. This innovation has previously been described in our columns.* The time is rapidly approaching when the spun material will monopolise the field covered by disc-like castings

Welfare.

Special facilities are available for and careful attention is given to the training of apprentices in the foundries and pattern shops. The boys are placed under the care of selected instructors, whose sole duty is that of training the boys.

Fig. 8.—A General View of the Heavy Foundry.

Fig. 9.—Another View of the Heavy Foundry.

Brass Foundry.

Housed in a separate building, as is shown in Fig. 2, the brass foundry is supplied with liquid metal by two Armstrong Whitworth rotary oil-fired furnaces of 8- and 3½-cwt. capacities, and by a battery of eight coke-fired pit furnaces. Of outstanding interest in this department are the "Craven" vertical centrifugal casting owing to their enhanced physical properties. Experiments with the design of a horizontal centrifugal casting machine, now located in the iron foundry, are rapidly approaching completion, and it is expected to be placed on the market in the course of a few weeks.

* "A New Centrifugal Casting Machine," Foundry Trade Journal, July 23, 1931, page 51.

Every encouragement is given for the apprentices to attend evening classes, and the firm pays their fees. We cannot say that we approve of this action under normal trading conditions, as in the local *argot* "owt for nowt" is rarely appreciated. An excellent canteen, shown in Fig. 11, is provided for the use of the operatives. This welfare work associated with the intensive training afforded by the management does ensure that the apprentices become highly-skilled artisans.

Conclusions.

Viewed from no matter what angle—established reputation, plant facilities, research activities and intelligent control—one can but arrive at the conclusion that the firm of Craven Brothers has created an organisation capable of providing the highest grade of castings available to the heavy engineering industries.

The Pig-iron Industry in Denmark.—Even allowing for difficulties in competing with the extraordinarily low prices offered in pig-iron by certain continental countries, British prices are prohibitive in the Danish market. British firms are always asked to quote, but their offers are generally unacceptable, to the great disappointment of public and private institutions in Denmark ready to favour Great Britain where possible. A much greater share of the imports was previously held by Great Britain; and another reason for the decline in sales will be found in the fact that in analysing the iron, the contents of foreign matter, are not stated in sufficiently exact terms. While British works will give a margin of 2 to 3 per cent. silicon, Continental makers will give the precise figure of, say, 2.7 per cent.; and as the advance in foundry technique requires very concise specifications, Continental makers are frequently favoured on account of their willingness to conform to any desired specification. There is, also, the question of the willingness of Continental works to ship small cargoes of 50-80 tons by smaller vessels from Dutch and North Sea ports, thus satisfying the immediate needs of the Danish foundries and eliminating the risk of price fluctuations.

Britishers Participating in the Paris Congress.

Mr. Andrew Harley, President of the International Committee, and Mrs. Harley; Sir J. Robert Cahill, Commercial Adviser, British Embassy, Paris; Sir Henry Fowler, President of the Institute of Metals, Mr. F. J. Cook, Mr. John Cameron, J.P., and Mr. V. C. Faulkner, (J. B. Corrie & Company, Victoria Street), Mr. A. W. G. Bagshawe (Bagshawe & Company, Dunstable), Mr. B. B. Kent (Sterling Manufacturing Company, Cubitt Town), Mr. S. Evans (Pitteville & Company, London and Brussels), Mr. G. T. Lunt (Bradley & Foster, Darlaston), Mr. R. A. Jones (W. & A. F. Jones, Manchester), Mr. E. Longden (Craven Brothers, Manchester) and Mrs. Longden, Mr. E. Millington (Metallurgist, L.M. & S. Railway Company, Derby), Mr. J. Halloran (Combustion Engineering Company, Derby) and Mrs. Halloran, Messrs. C. R. and A. B. Smith (C. & B. Smith, Wolverhampton), Mr. Hargreaves and Mr. Turbot (of the Southern Railway shops at Ashford), Mr. G. C. Castle (Beecroft & Partners), Mr. D. G. Mather (Mather & Smith, Ashford), Mr. R. B. Templeton (Ealing Park Foundry), and, of course, Mr. T. Makemson, the Secretary of the Institute of British Foundrymen, who was accompanied by his sister, Mrs. Tomlinson.

all Past-Presidents of the Institute of British Foundrymen; Mr. J. G. Pearce, Director, British Cast Iron Research Association, and Miss Helen Pearce; Capt. V. Delport, European Representative of the American Foundrymen's Association, and Mrs. Delport; Dr. D. H. Ingall, Assistant Director, British Non-Ferrous Metals Research Association, and Mr. G. R. Bailey, also of that Association; Mr. J. E. Fletcher, Consultant to the B.C.I.R.A.; Mr. J. B. Corrie

Fig. 10.—The Light Bay, a Corner of which is used for Training Apprentices.

Fig. 11.—The Workmen's Canteen, Messrs. Craven Bros.

The Scrap Metal Position.

By "Onlooker."

Perhaps in no section of the non-ferrous metal trade has the sudden uprush of prices and the dramatic alteration in values been more in evidence than in their relation to scrap. As far as the primary metals are concerned consumers have been able all through the rise to purchase what they needed—at a price, but a very different situation has obtained in scrap and would-be buyers have had the greatest possible difficulty in persuading holders to part with metal. This is not altogether to be wondered at, for much of the scrap which has been held off the market ever since the price of copper fell below £40 was accumulated at a time when values were ruling a good deal higher than they are to-day. As a matter of fact, it was almost impossible to buy scrap, when, during June and July virgin metal values were bumping on the bottom, for things had got to the point when it simply did not pay to recover old material.

Influence of Raw Retail Metal.

So rapid has been the appreciation in the official quotations of the non-ferrous metal quartette that scrap dealers have hardly found it possible to adjust prices rapidly enough to make business possible, and such deals as have been put through are mostly the result of a foundry being short of raw material and having to get hold of supplies at the best possible price in the circumstances. The real difficulty, until some kind of stability is reached, obtains in the fact that the people who are actually holding stocks of old metals will not release them until they feel reasonably sure that there is no further appreciation left in the market. This policy is, however, rather a short-sighted one, for consumers are quite as much alive to market movements as anybody else and they are out to avoid buying at the top of the rise. Some of the bolder spirits among the scrap merchants have elected to take orders at the very best price obtainable, cover the sale by a purchase of three months' standard and await for the opportunity to secure the necessary physical metal. This plan is feasible when the customer is prepared to await delivery but the merchant runs a rather awkward risk and very few are prepared to take such a chance when the prospects of a reasonable profit are small.

The Case of Gun-Metal Scrap.

Evidence that a time had come in the course of base metal prices completely altered the mental reaction of consumers to the possibilities of a situation, which less than a couple of months ago looked hopeless in the extreme. So hopeless did it seem that users of scrap metal failed for the most part to take full advantage of low prices and cover, at any rate, part of their forward needs, as a result of which many of them now find themselves in a very awkward fix and unable to decide what to do for the best. Perhaps old gun-metal is as good an illustration as anything of the sudden change which has come over the scrap situation during the past few weeks, for whereas up to the end of July it was almost impossible to find a buyer for gun-metal, and the price declined to a ridiculously low point, the position now is that consumers are keen and the fortunate possessors of the gun-metal scrap are acting with a good deal of reserve. The fact that copper has gone up by about 50 per cent. and tin by about £25 has materially altered the mixing value of gun-metal, and no doubt many users of this material are looking back sadly to lost opportunities.

A Better Outlook.

The future for the scrap metal trade is, however, now looking better than it did when virgin

(*Concluded on page* 194.)

Black Sand.

By Ben Hird.

The author apologises for the delay in publishing this Paper. The first part was given before the Newcastle, Burnley, and South Wales and Monmouthshire Branches of the Institute of British Foundrymen* early this year. The desire further to develop certain theories and to try them out in practice over a period is the reason for the delay. It will be observed this Paper is a continuation of the investigations made some time ago into the action of coal dust when added to moulding sand.

The following experiments and tests were made to find out some of the effects of coal dust on sand. A series of castings was made in the same mixing of sand (new red sand plus 10 per cent. of coal dust) without any further additions. One series was hand-mixed and the other milled after each cast. The object was to try to find the "life" of the sand and its condition after repeated casts, and also the difference between hand-mixing and milling.

The following results of the tests made have been tabulated: (*a*) Condition of sand in mould after each cast, (*b*) appearance of casting, (*c*) volume of gas given off from sand during each cast, (*d*) permeability and strength of sand after each cast and (*e*) appearance of sand under magnification after each cast.

The following materials were used: A red sand known as Stourbridge medium and a coal dust marketed as Tirpentwys "Fine" and containing 28 to 30 per cent. volatile matter. The mixture used was red sand plus 10 per cent. of coal dust. The *hand-mixed series* was well turned over by the shovel and put twice through a ⅛-in. sieve. The *milled series* was mixed and milled for three minutes in a combined mixer and mill. As a test casting a rectangular block, 12 in. by 8 in. by 2¼ in. weighing 64½ lbs., was used. It occupied approximately one-fifth the volume of the box (an ordinary pressed-steel box having no bars). The first three castings of each series were made in a 16-in. by 14-in. by 4-in. box part and the next three in a 16-in. by 12-in. by 4-in. This was done to provide for loss of sand.

* "Coal Dust as Applied to Moulding Sand," Foundry Trade Journal, June 27, 1929, page 493.

Apparatus Used.

For estimating the gas pressure the apparatus shown in Fig. 1 was used. This is an adaptation from the more scientific one used by F. Maske and E. Piwowarsky and described in an excellent and interesting article entitled "The Gas Permeability of Moulding Sand," and published in The Foundry Trade Journal, March 28, 1929. It comprises a "gas-collecting pot" of 3 in. inside diameter by 4 in. high having a sealed end, which is drilled to take a short length of ¼-in. gas pipe. One end has a 1-in. to ¼-in. reducing socket screwed on. This socket is covered with fine gauze to prevent sand entering into the pipe. The sealed top of the pot also has a small tap fitted to act as a safety valve. The "gas pot" is rammed with the sand used for the mould, the end of the socket being set back 1½ in. into the pot. The top face of the wooden pattern is recessed down ¼ in. to the outside diameter of the pot, and thus allows the pot to stand out from the face of the mould after the top is rammed up. When the mould is cast this forms an effective seal. Before casting, a thin covering of plaster-of-paris is run over the top of the gas pot to prevent gas escaping from around the ¼-in. gas pipe projecting from the pot. This is then connected up to a "U" tube pressure gauge fixed on to a board. A strip of paper is pinned alongside the tube on which the pressure and time results are recorded when the mould is poured.

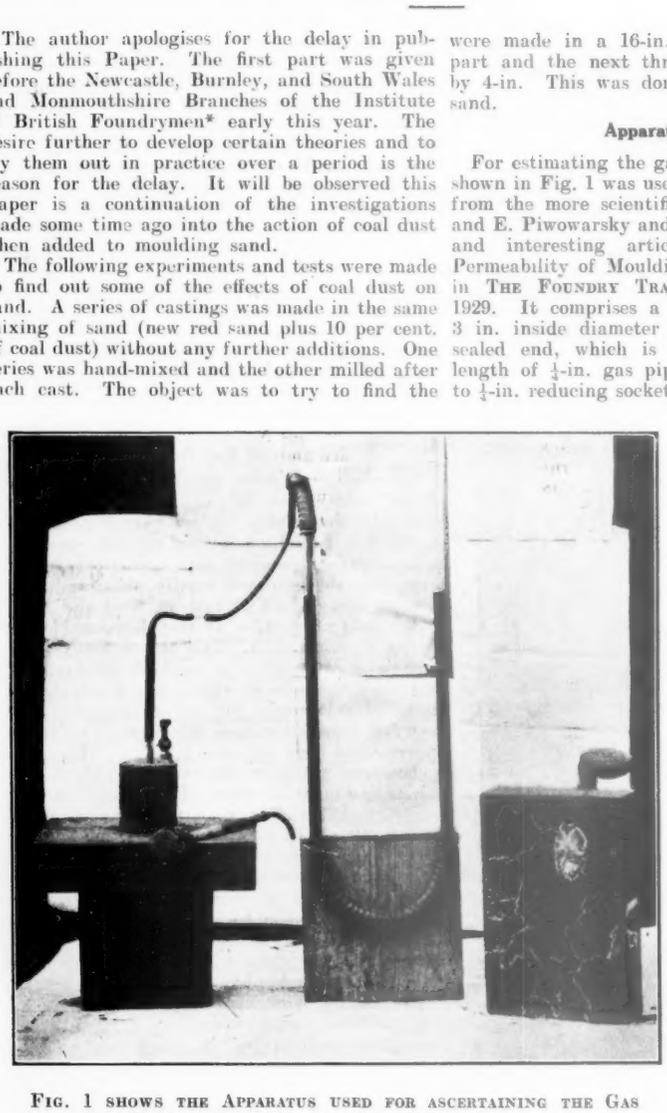

Fig. 1 shows the Apparatus used for ascertaining the Gas Pressure and Type of Test Casting made.

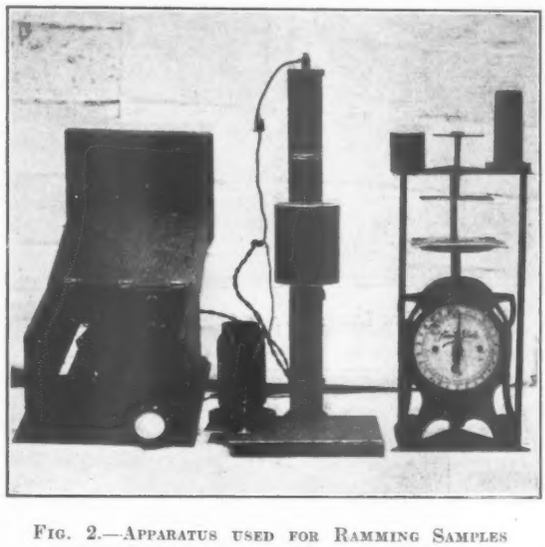

Fig. 2.—Apparatus used for Ramming Samples and determining the Moisture Content.

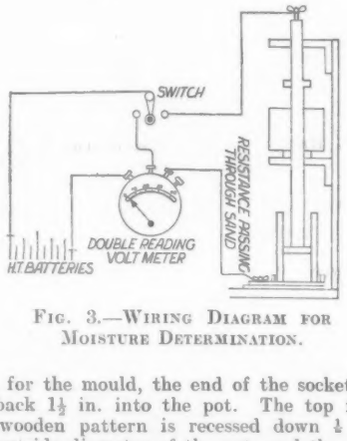

Fig. 3.—Wiring Diagram for Moisture Determination.

Sand Testing.

The rammer and electrical moisture set shown in Fig. 2 has been developed by Mr. R. J. Richardson, of Messrs. Brown, Lenox, Limited, Steel Works, Pontypridd, for estimating the moisture content, permeability and strength of sands. The rammer is adapted from the American Foundrymen's Association design, and is constructed from an iron base-plate, with an upright arm. This carries two angle brackets, through which runs a round spindle having two collars set at a given distance apart. Between these slides a weight, which can be lifted and dropped a given number of times, transferring the force of the blow through the plunger at the end of the rod to the sand in the cylinder. At the top of the rod is a terminal for attaching a wire, and on the base-plate is laid a sheet of ebonite to insulate the cylinder. The cylinder in which the samples are rammed is an ebonite tube 6 in. long with 2 in. inside diameter, with a threaded metal ring fixed firmly to the bottom end. This screws into a corresponding ring fastened to a brass plate, having a terminal for attaching the other wire.

The Electrical Moisture Set.—This consists of a high-tension battery, grid-bias battery, a three-way switch and a Mill's or double-reading voltmeter, wired up as follows: One wire leads from the high-tension battery to the centre terminal of the switch, and it can be switched over to the left on to the terminal of the meter reading high voltage. The other wire from the high-tension battery leads to the earth terminal of the meter. Thus, by moving the plugs in the battery, a standard voltage can be obtained. On the other side the wire goes from the right-hand terminal of the switch to the top terminal on the rammer, then from the terminal on the cylinder plate to the low-voltage terminal on the meter, which records the voltage of the current passing through the sand. The voltage, therefore, will vary with the moisture content of the sand as shown in the wiring of the diagram in Fig. 3.

Permeability.

This apparatus, shown in Fig. 4, for determining this, consists of two containers, the top acting as a reservoir and the bottom as a compression chamber for the air which is forced through the sample. The top container can be fitted with a ball-cock or gauge-glass. A water-pipe is taken from the base of this container through a stop-cock into the base of the bottom container, which is fitted with a drain-cock and gauge-glass. Fixed to the top of this tank is a threaded ring into which the cylinder containing the test-piece can be screwed. Two pipes, one leading into the top of the tank and the other to the water-gauge, are taken from the bottom of the threaded ring, which has a solid bottom. The sand sample rammed in the cylinder acts as a cork; thus the closer (or less permeable) the sand the higher the pressure in the tank, which is recorded on a water-pressure gauge and measured off in inches.

Strength.

This determination is made by utilising an ordinary spring-balance scale (Fig. 2) which

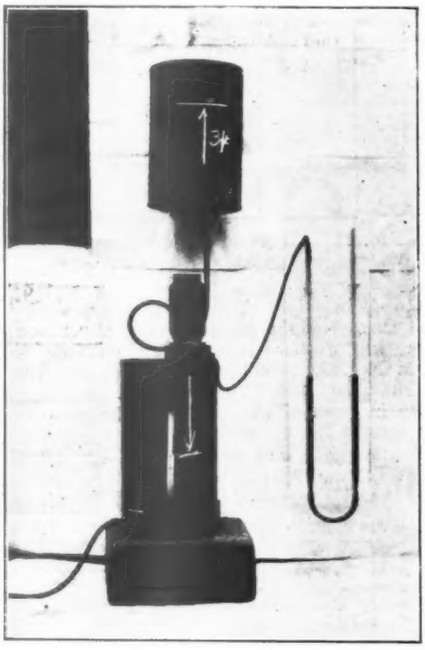

FIG. 4.—PERMEABILITY APPARATUS USED IN THE TESTS.

stands inside a triangular stand; the top plate is threaded to take a bolt. On the bottom of the bolt an aluminium plate is loosely fixed. Another similar plate is fitted to the platform of the scale. The sample is then placed on this, and by screwing down the bolt the pressure in lbs. is recorded on the scale.

Black sand is the used sand which forms the bulk of the sand in all foundries using coal-dust additions. It is made from the red or yellow new sand plus coal dust by the moulding process of producing castings.

How it is Formed.

The fine particles of coal dust when mixed with the sand adhere to the sand grains. This sand is then rammed and a mould made, a portion of the sand forms the face of the mould. When the molten metal enters the mould this sand forming the face is suddenly raised to a very high temperature. As the molten metal nears the specks of coal dust on these face grains they instantly give off their volatile matter in the form of heavy coal gas. Some of this is trapped between the mould face and the flowing metal, and is the outstanding factor in producing the blue skin on the casting and promoting clean stripping. As the metal covers the faces of the mould these volatile gases are forced back through the pore spaces between the grains of sand to the cooler sections behind, where the volatile matter condenses on the sand grains in the form of black carbon and tarry matter. At the same time specks of coal dust just away from direct contact with the molten metal soften or melt into a tarry substance—an action which bonds the grains of sand together. As the heat from the metal penetrates deeper into the sand,

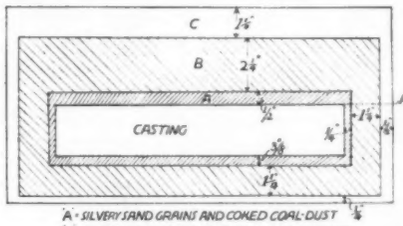

FIG. 5.—SHOWING THE INFLUENCE OF MOLTEN METAL ON THE COAL DUST CONTAINED IN MOULDING SAND.

the volatile matter is again vaporised and driven farther back, leaving the carbon in the form of fine coke attached to and intermingled with the sand grains. This process continues until the limit of the heat penetration is reached.

F. Maske and E. Piwowarsky, in the Paper referred to, give the following temperatures of the sand at varying distances from the face of the casting:—

SIZE OF CASTING, 10½ IN. DIA. × 1¼ IN. THICK.

At moment of content with mould face.	800–900 Deg. C.
2 mins. after casting T. $\frac{1}{32}$ in. from face of casting	700–800
5 ,, ,, ,, $\frac{3}{32}$,, ,, ,, ,,	700
8 ,, ,, ,, $\frac{1}{4}$,, ,, ,, ,,	600
20 ,, ,, ,, $\frac{5}{8}$,, ,, ,, ,,	400
30 ,, ,, ,, $1\frac{1}{8}$,, ,, ,, ,,	300

The sand in the mould acts in a similar way to a filter-bed or scrubber removing the tarry matter and carbon from the coal gas. The depth

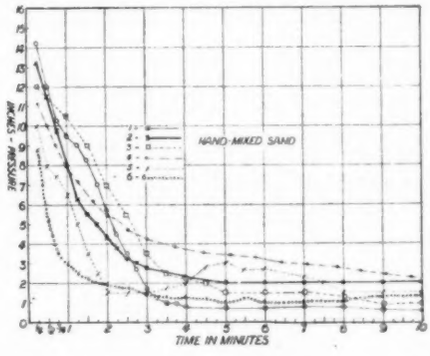

FIG. 6.—RESULTS OBTAINED FROM THE HAND-MIXED SERIES.

of this penetration of carbon depends on the thickness and weight of the castings and the amount of volatile matter mixed in the sand. This is shown in the diagram (Fig. 5) of the penetration after casting.

Results of Tests on New Red Sand + 10 per cent. of Coal Dust.

Condition of Sand in Mould after Casting.—The sectional diagram (Fig. 5) shows approximately the effect of the heat from the casting on the sand in No. 1 hand-mixed series. It shows also the depth of carbon-coated silvery grains of sand, bonded with well-coked coal grains, and behind this the grains of sand are black, tarry, carbon-coated, with partly-coked coal grains (as described in the author's previous Paper* on "Coal Dust"). No. 2 had no silvery grains but the black, tarry bonded portion extended to about the same depth. In Nos. 3, 4, 5 and 6 clear white grains began to appear on the face, increasing in amount up to about $\frac{1}{16}$ in., but in No. 6, whilst the depth of tarry bonded sand decreased to about half, or approximately 1 in. The milled series followed very closely the same conditions with the remarkable exception of No. 1A, which showed *no* sign of silvery grains or hard coking. This was afterwards checked a second time and the results were the same.

Appearance of Castings.—In the hand-mixed series No. 1, a perfect casting, having a blue skin with a few silvery patches, resulted. The sand stripped off clean and without brushing. Nos. 2, 3, 4 and 5 were all good castings, but the colour and the smoothness of the skin deteriorated with each successive cast. No. 6 was sand badly burnt on, whilst the top was slightly drawn down.

The milled series No. 1A had a big blind scab on the top face and a large wave mark on bottom face, but still had a smooth, blue skin. Obviously the sand was unsuitable for the job. Nos. 2, 3, 4, 5 and 6 A's were all good castings, but the colour and the smoothness of skin were deteriora-

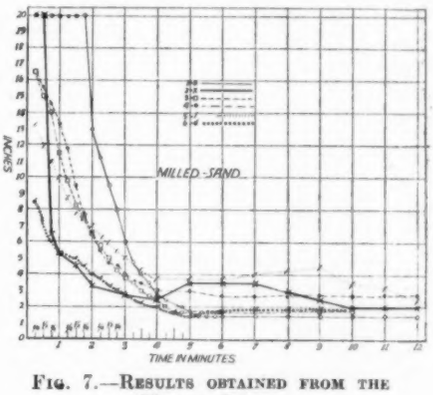

FIG. 7.—RESULTS OBTAINED FROM THE MILLED SERIES.

ting after each cast, yet, generally speaking, they were better than the "hand-mixed" samples.

Gas Tests.

As one of the objects of these tests was to find the amount of gas given off by coal dust and volatiles left in the sand after each cast, the sand was dried in the gas pot before ramming it up in the mould. The curves shown in Fig. 6 represent the results obtained from the hand-mixed series. These showed, as would be expected, a gradual decrease in the volume of gas after each successive cast, due to the burning out of the volatiles. The most interesting feature about these tests is the very pronounced difference between the hand-mixed and the milled series.

The curves in Fig. 7 show a remarkable increase in pressure and volume of gas from the milled sand, especially in Nos. 1A and 2A. With No. 1A the pressure pushed the water in the tube up to the 20-in. limit seven times in 1¾ min., *i.e.*, when the 20-in. limit is reached the small tap on the gas pot is opened and the pressure at once drops to zero; the tap is then closed and pressure again recorded. The results shown by this test suggest some direct connection with the condition of sand and appearance of casting in No. 1A milled series as compared with No. 1 hand-mixed that warrant further investigation.

Permeability and Strength Tests.

These tests shown in Figs. 8 and 9 were taken with the apparatus shown in Figs. 2 and 4. For each sample the American Foundrymen's Association standard core, 2-in. dia. by 2 in.

long, was given three blows with the drop rammer. Each sample was dried and 5 per cent. moisture added, thus keeping the moisture content constant. With the "hand-mixed series" the results appear to be about normal. The addition of fine coal dust to the new red sand decreases its permeability and increases its strength slightly; with successive casts permeability increases and strength decreases. In striking contrast, the "milled sand" shows an increase in strength after each successive cast. Reviewing this unexpected feature, it appears obvious that the sand was gaining bond from some source other than the alumina or claybond of the red-sand grains. At 5A there was no sign of red-sand grains in the sand, every grain being covered with a carbon coating which obviously destroyed the clay bond on the sand grain, yet its strength was equal to the milled new red sand. This suggested a "carbon bond" created

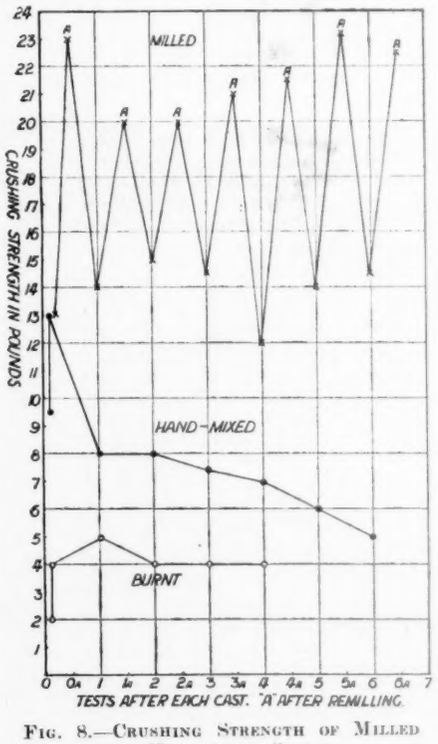

FIG. 8.—CRUSHING STRENGTH OF MILLED AND HAND-MIXED SERIES.

by the action of the coal dust, and microscopic examination supported this theory.

Appearance of Sand under Magnification.

The "hand-mixed" series "O" as mixed before casting showed at 40 dias. red grains with specks of coal dust adhering to the clay bond and also specks of free coal dust. After the first casting, however, a mixture of red grains and black carbon-coated grains was still showing, with small coke-like adhesions—like limpet shells on a rock. Samples Nos. 2, 3 and 4 were similar, but the quantity of black grains was increasing and the red ones decreasing, whilst a few clear grains were beginning to show. In samples Nos. 5 and 6 there was considerable increase in clear grains, whilst all the rest were black.

The "milled" series "OA," after mixing and milling, showed dark red grains with the coal dust well rubbed into the clay bond. After the first cast (1A) the grains were unchanged and showed dark red grains bonded with tarry carbon, *i.e.*, the coal is just breaking down together with black carbon-coated grains having coke-like adhesions. Milling induces coke adhesions which appear to be slightly rubbed down, whilst the bonded clusters are broken up somewhat. After the second cast (2A) very few unchanged grains of sand remain as compared with No. 2 "hand mixed" and No. 1A "milled." Mostly tarry and carbon coated as described is revealed. After remilling, there was the same slight change as previously noted. Whilst Nos. 3A and 4A were very similar to No. 2A, in Nos. 5A and 6A all grains of sand were shown to be thoroughly carbon-coated with the exception of a few clear grains, where the carbon had burnt off.

"Carbon Bond."

Experiments were carried out on similar lines to the previous ones, but the gas test was omitted, owing to the difficulty of holding the sand in the gas-pot when dried. Only five tests

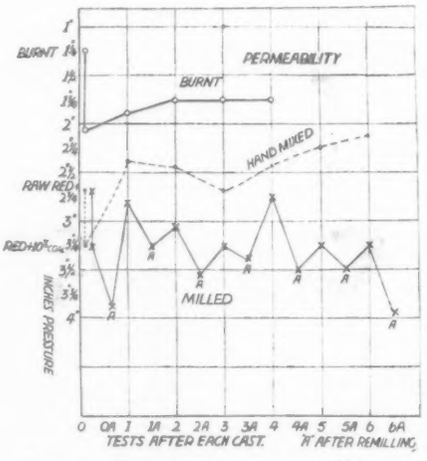

FIG. 9.—PERMEABILITY OF THE MILLED AND HAND-MIXED SERIES.

were taken of the hand-mixed series, four with and one without coal-dust additions.

"Hand-Mixed" Materials.—The burnt sand, *i.e.*, the ordinary black sand, burnt by air action on to the castings, was removed from the moulds in a red-hot condition. Ten per cent. of coal dust was added and the batch was thoroughly mixed with 5 per cent. water. Two wooden bars,

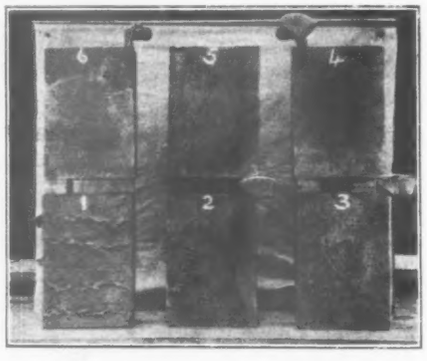

FIG. 10.—THE APPEARANCE OF THE TEST CASTINGS, SHOWING THE PROGRESSIVE IMPROVEMENT OF THE SKIN.

bristling with nails, were wedged into the top-part box to carry the sand which had practically no bond; these bars were used for all five tests. A sheet of paper was used to split the joint. The condition of the sand in mould "O" showed only burnt sand, as all the sand was powdery and free from caking or bonding. In reality there was no change in the condition.

After an addition of 10 per cent. of coal dust (Test No. 1), the results were very similar in effect to No. 1 of the hand-mixed series (new sand). Compared with Fig. 5, the silvery-coking area "A" was $\frac{3}{8}$ in. thick; that of the tarry-bonded sand B was 2 in. thick in the top part. The casting lifted out of the bottom part leaving the mould almost intact and the sand was so well bonded by coke and tarry matter that it could be lifted out by hand in large pieces. The conditions for Tests Nos. 2, 3 and 4 were that no silvery coking at "A" was shown (Fig. 5), but there was an increase of clear burnt sand grains from $\frac{1}{32}$ in. in Test No. 2 to $\frac{1}{8}$ in. in Test No. 4, whilst the depth of the tarry-bonded section "B" decreased to $\frac{3}{4}$ in. in No. 4. The condition of the castings "O" was such that the bottom face was all swilled away in front of the runner, whilst the top was badly pulled down all over. Moreover, the skin was very rough and grey. The results of these tests are shown in Fig. 1. Test No. 1 illustrates that the swill from the pitch of the runner has caused a lump; it is badly mapped and exhibits fins from

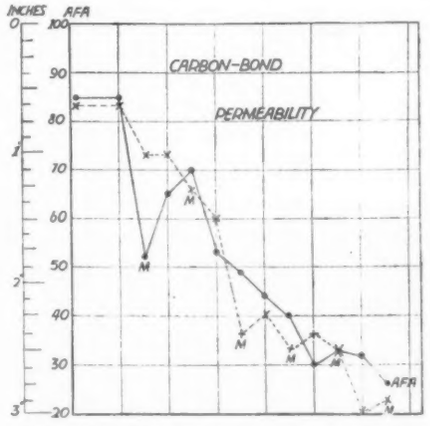

FIG. 11.—PERMEABILITY OF CARBON-BONDED MOULDING SAND.

$\frac{1}{16}$ to $\frac{3}{32}$ in. high. The top face was good but still showed slight mapping, and the blue-grey skin was rather rough. The castings from Tests Nos. 2, 3 and 4 were good, but had a rough grey skin. There was a slight pull-down in front of the runner in the case of the top face of No. 4.

The strength and permeability are portrayed in Figs. 8 and 9, from which it will be seen that Test No. 1 shows a slight increase in strength,

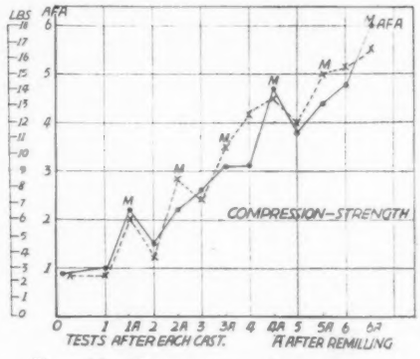

FIG. 12.—COMPRESSION STRENGTH OF CARBON-BONDED MOULDING SANDS.

followed by a slight decrease in Tests Nos. 2, 3 and 4, whilst the permeability shows a slight increase.

Milled Series.

It was decided to make an alteration in this series and to use a sharp sand to ensure entire absence of bond, and add a small percentage of coal dust to replace any loss in burning. The sand used was a Briton Ferry dune sand, and 10 per cent. of coal dust was added and the batch hand-mixed with 5 per cent. of water. The first mould was made, using the wood bars in the top part and a sheet of paper to split the joint. After this cast, a further $2\frac{1}{2}$ per cent. of

(*Concluded on page* 192.)

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RANGE OF ANALYSIS

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Silicon	2% to 5%	1% to 3%
Sulphur	·01% to ·04%	·04%
Phosphorus	1·6%	·5% to ·8%
Manganese	·35%	·5% to ·1%

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(*Concluded from page* 190.)

coal dust was added and the sand mixed and milled for 3 mins. This was repeated after each cast and the following surprising results were forthcoming:—

Condition of Sand.—The result of the first test was similar to No. 1 burnt sand and No. 1 hand-mixed red sand. Imposing these results on Fig. 5, it would read: Silvery-coking "A" section, ½ in. deep; tarry-bonded "B" section, 1¾ in. thick in the top part. After milling, the bond had increased so much that the wooden bars were left out of the top part. After casting there was no silvery coking at "A" (Fig. 5), whilst "B" was about 2 in. thick. In the case of Tests Nos. 3, 4, 5 and 6 there was no silvery coking or white burnt grains on the face, and it was difficult to ascertain the depth of the penetration of black tarry matter. The sand had developed a bond equal to a good milled facing sand and was used ordinarily with sharp sand to part the joint. The appearance of these castings are shown in Fig. 10, from which it will be noted that in the case of No. 1 the face was badly pulled down, the bottom was good but very slightly mapped, whilst the skin was blue but rather rough. No. 2 was very slightly pulled down at one corner, but the rest of the casting possessed a good skin and was slightly better than No. 1.

Nos. 3, 4, 5 and 6 were all good sound castings having a fairly good blue skin.

Strength and Permeability.

The strength curves of these sands shown in Fig. 11 demonstrate very clearly the surprising increase in bonding strength brought about by the successive casting, milling and coal-dust additions. The permeability decreases, as would be expected, but No. 6 is well within the limits for ordinary moulding sand. The results taken with the apparatus described in this Paper are shown by the dotted line and the check results on a standard American Foundrymen's Association apparatus by a full line.

Practical Application.

From the results of the tests described, it appeared to be unnecessary to add new sand to keep up the strength of the black sand, and this has been tried out in practice on two continuous-casting plants over a period of three months. Each casting plant is equipped with a self-contained sand-mixing plant, having a mill of the combined mixing, milling and aerating type. The sand is thus used repeatedly about 12 times a day, and the weight of each casting is 46 lbs. Approximately 1,000 tons of castings have been made on each plant without the addition of any new sand. Actually 2½ per cent. of coal dust is added to each batch of sand as it goes through the mill. The sand is still giving satisfactory results.

The theory advanced is that by the addition of coal dust the grains of sand acquire a rough carbon coating by the casting process as described; also the limpet-like coke adhesions, which become sharp projections during grinding, provide a mechanical bond and replace the clay bond which has been destroyed.

Conclusions.

These investigations and practical tests further emphasise the statements made by many foundrymen and investigators into the problems of sand mixing. It has been shown that by efficient mixing and milling large quantities of new sand can be saved in the foundries. The theories are put forward with due deference, knowing full well that upon further investigation they may be found to be in error or badly conceived, but the claim that the subject of black sand is worthy of further and fuller investigation cannot be denied. The previous Paper on "Coal Dust" was started to investigate the practice of moulders who added extra coal dust to facing sand to stop scabbing, and wrongly termed it "opening the sand." There is now convincing proof that they were right. Coal dust wisely added will stop scabbing and "drawing down," not by opening the sand but because the specks of coal on the approach of the molten iron rapidly changes into tarry matter which binds the grains of sand together as described at the beginning of the Paper. The author concludes by duly acknowledging the old craftsmen who were the first to add coal dust to moulding sand.

Publications Received.

Frasers (Canadian) Directory. Published by the Fraser Publishing Company, 1070, Bleury Street, Montreal. Price 3 Canadian dollars.

The lay-out of this Canadian Directory is to list a product or a service and then to detail the names of those selling it, followed by lists of firms outside of Canada having representatives in that Dominion. It takes about 10 pages of two columns to cover the foundry industry. In glancing through the list, we failed to see noted the railroad foundries. In general, however, the directory has been very carefully prepared, and especially interesting is the list of foreign firms represented there as showing the American and European competition to be expected.

Armstrong - Whitworth Products. — This brochure is what Mr. Winston Churchill might call a terminological inexactitude, as it is confined to the products of Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited, of Scotswood Works, Newcastle-upon-Tyne, and does not include those of their associated companies of similar but qualifying names. We suggest that it might be called Volume I to overcome the difficulty. The cover is beautifully presented, whilst the contents are extremely well written and adequately illustrated. Moreover, a splendid balance has been maintained, except, perhaps, the efficiency of the Armstrong-Saurer engine is insufficiently stressed. About one-third of the products listed are used in foundries, and sections are devoted to pneumatic tools, metal-melting furnaces, pressure-die casting machines, fuel-testing and general engineering plant. We hope that our readers will make a note of the fact that this concern are specialists in the manufacture of die-casting machines, as we are constantly being asked for the names of manufacturers of such plant. A feature of the pneumatic-tool section is the stressing of the fact they have organised a fleet of service cars to enable customers to get the best out of the tools supplied. Amongst the tools described is a portable grinder, fitted with a 6-in. bakelite-bonded wheel, which can be removed and replaced by a wire brush—a choice of handle-type is also given. A feature of the brochure is the listing on the last page of the catalogues which have been issued by the firm, and their enterprise is shown by the fact that about 40 are in foreign languages. The book is characteristic of the highest grade of British technical-publicity matter.

Monel Metal in Building Construction.—Experience has established four specific advantages of Monel metal for utilitarian architectural use. In the first place it can be brazed, welded, or soldered in place, making it possible permanently to establish an absolutely watertight condition. Second, it can be seamed if desired, using the double lock seam customarily employed with copper or other softer roofing metals. Third, it is stronger than mild steel, a quality that fits it for the insulated deck type of roofing and permits the use of wider spans which allows a reduction in the number of structural supports. Fourth, its durability makes possible the use of lighter gauge sheets than could be possible with less permanent materials. This reduces its relative weight and cost. Another more recent development of Monel metal for building purposes is found in expansion joints.

Death of Mr. J. Little.

A PAST-PRESIDENT OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

We deeply regret to record the death of Mr. J. Little at the age of 70 at Southport, where he had lived in retirement since 1930. Mr. Little, who was the son of a London foundryman, started work at the age of 13 as an office boy at Cammell Laird's Grimesthorpe Works, Sheffield, where his father was foreman pattern-maker. At the age of 15 he entered the pattern shop, and when just out of his teens passed into the drawing office. He spent a short period at the Penistone and Workington Works of Cammell Laird, and by 1902 was appointed general manager of the Grimesthorpe Works. This was a period of great development in the metallurgical industries, and he supervised the manufacture of thousands of tons of armour plate and the largest type of steel castings. Just before the war, in 1913, Mr. Little joined the Institute of British Foundrymen, and immediately became active. He presided twice over the Sheffield Branch, and became President of the Institute in 1919. He succeeded in office his great friend, the late Mr. T. H. Firth, of Brightside Foundry. It was about this time that these two gentlemen, in collaboration with Mr. Matt Riddell and the late Mr. Oliver Stubbs, worked for and obtained a Royal Charter for the Institute of British Foundrymen. His was the first of the post-war presidential addresses, and his was a very eloquent plea for more conscientious hard work now that a shorter working day had become the law of the land. He had very decided views upon apprenticeship, and pleaded for a restoration of the old-time indentures for an apprentice, coupled with day-continuation technical classes. Whilst he himself had gained his scholarship and erudition by evening study, he wished to eliminate this fatiguous method of gaining knowledge from the curriculum of the modern youth. He was a great believer in quantity production, and stated that we had nothing to learn about quality in this country. If his notions had been adopted earlier, the foundry industry would be in a better position to-day. He concluded his Address by saying: "We are in this new campaign for a plain issue—industrial and commercial life or death—and the man or section of men neglecting the least opportunity of assisting the country to win is a traitor." Thus it was that Mr. Little was the last President of the British Foundrymen's Association and the first President of the Institute of British Foundrymen. It is interesting to learn that when the Sheffield Technical School (now the Department of Applied Science of Sheffield University) was established it was Mr. Little who made the drawings for the conversion of the old Grammar School into its new form. After 54½ years with Cammell Laird he resigned and took an active interest in municipal matters at Southport, where for many years he presided with distinction over the Electricity Committee of that town. He was also a member of the Institution of Mechanical Engineers, and was a founder and President of the Sheffield section of the Junior Engineers. Mr. Little was a widower and leaves no family.

New Alloy for Dairy Equipment.—A new alloy combining strength and resistance to corrosion and tarnish with a facility of manufacture that makes it readily workable in all commercial forms has been announced by the Development and Research Department of The International Nickel Company. It was developed especially for dairy machinery. This new Inco chrome nickel is a nickel-base alloy containing chromium and a slight amount of iron. Tested under actual operating conditions it has shown high resistance to the tarnish of dairy products, brines and cleansing agents. It is being produced in the form of sheets, bars, tubes and castings.

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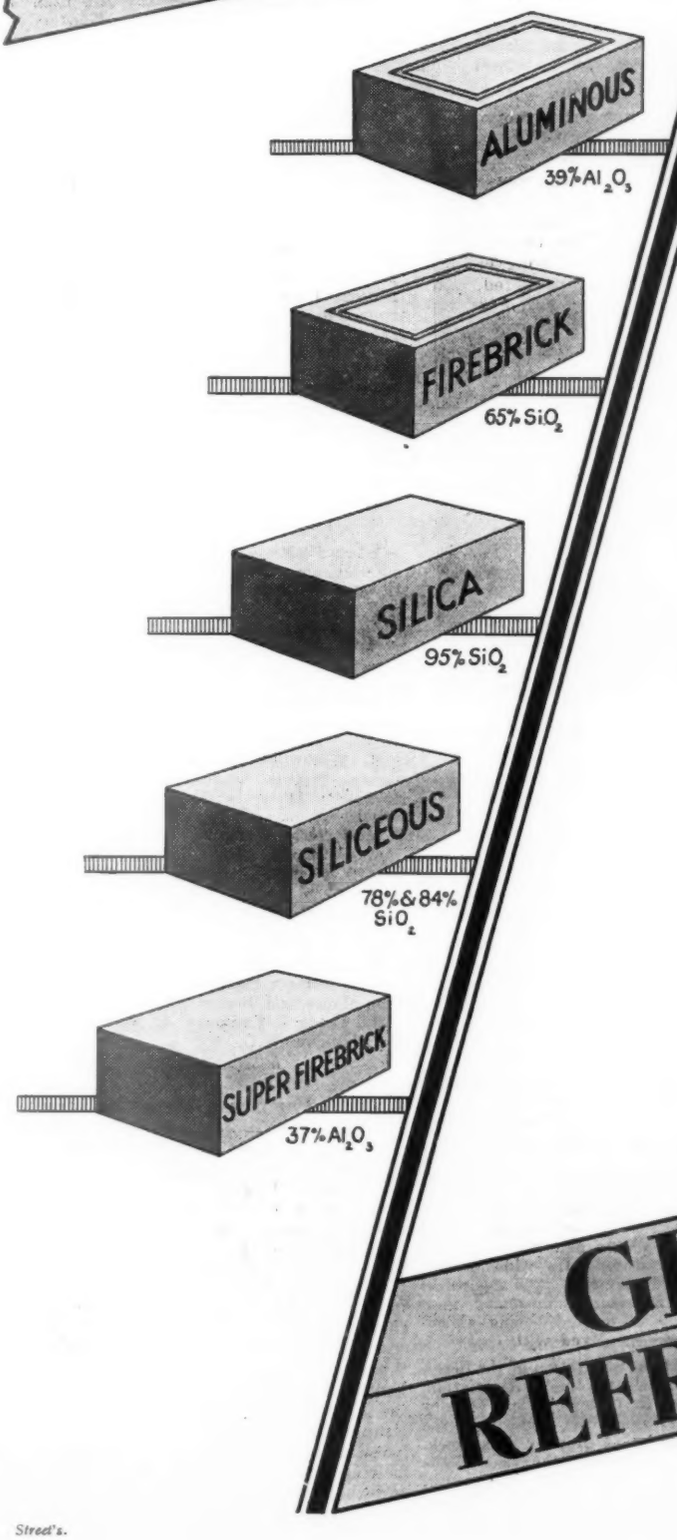

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GIBBONS REFRACTORIES

Street's.

This Week's News in Brief.

Trade Talk.

More than 10,000 visitors viewed the exhibits on the Vicker's Stand at the British Exhibition at Copenhagen last Sunday.

The United Kingdom Ferro-Manganese Company, Limited, has removed from 305 to 328, Winchester House, Old Broad Street, London, E.C.2.

The Lord Mayor of London (Sir Maurice Jenks) will open the eighth International Exhibition of Inventions at the Central Hall, Westminster, on Wednesday, October 5. The exhibition will remain open until Saturday, October 15.

The British Consul at Riga reports that the following have been deleted from the list of goods subject to quota restriction on importation into Latvia :—Tariff Nos. 140 (1) and 142 (1) : Iron and steel castings, also blooms; scrap, shavings, powder; old wares only serviceable as raw material.

The first open-hearth furnace of the Stalin metallurgical plant at Kuznetsk, in Siberia, has begun melting steel. Three more open-hearth furnaces are under construction, and the plant, when completed, will include fifteen open-hearth furnaces with a yearly output stated to be 1,450,000 tons of steel.

Messrs. Edward G. Herbert, Limited, Atlas Works, Levenshulme, Manchester, have entered into an agreement with the Tinius Olsen Testing Machine Company, of Philadelphia, to manufacture under licence at Levenshulme the range of Olsen-Lundgren static-dynamic balancing machines for balancing crankshafts, flywheels, armatures, rotors, etc.

Mr. A. J. Grant, President of the National Federation of Iron and Steel Manufacturers and managing director of Messrs. Thos. Firth & John Brown, Limited, was the chief guest of the Sheffield Chamber of Commerce at the quarterly luncheon of the Chamber. He spoke of the work of the iron and steel trade delegation to the Ottawa Conference.

The proposed creation of a further 50,000 cumulative preference shares by the Metal Box Company, Limited, is, it is understood, for the purpose of completing the acquisition of the entire capital of the British Can Company, Limited, which was formed in 1929, under American auspices, to operate in this country. These shares are being acquired by an exchange of preference shares under an offer recently made.

The Aluminium Company of Canada, which is controlled by United States interests, has arranged to sell to the Soviet Government supplies of aluminium wire and cables needed for its electrification programme, and to take oil in exchange. A statement issued by the Aluminium Company says that it is "in effect, but not literally," trading aluminium products for oil. A Soviet oil tanker has arrived at Montreal with a first cargo of 9,000 tons of oil.

By Legislative Decree dated July 11 a number of modifications have been made in the Salvadorean Customs tariff. The goods affected include iron and steel, aluminium, copper, brass, tin, lead, zinc and nickel in an unmanufactured state, galvanised-iron wire, rims and plates of iron or steel, tinplate and copper wire or cable. New headings have been raised for certain articles, including iron or steel rivets. Particulars of the new rates of duty, etc., may be obtained from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

The League of Industry will consider at a conference to be held at Leamington at the end of this month a memorandum, submitted by the national executive, on the future work of the League. The memorandum states that the adoption of a tariff, while it leaves work to be done on this side of the League's activity, throws other objects into clearer relief, and especially that which aims at the creation between employers and employed of a spirit of co-operation so as jointly to promote and further any proposals for the improvement of their respective industries and the general industry of the nation. Three matters given as calling for attention now or in the immediate future are the burden of direct taxation on industry, the cessation of the flow of new capital into the risk-bearing side of industry, and improvements in the system of unemployment insurance.

A party of Danish municipal engineers arrived in London last Sunday for a tour of inspection of various industrial establishments in England and Scotland. The visit is taking place under the auspices of the British Steelwork Association in co-operation with the Danish British Association for Trade of Copenhagen. The purpose of the visit is to afford these Danish engineers an insight into British industrial methods and the wide range and high quality of British steel and engineering products. British trade with Denmark in these products is susceptible of considerable expansion and everywhere in Denmark great sympathy is extended towards goods of British manufacture. The visit will include excursions to prominent public works.

The Late Mr. J. Little.

[*His obituary notice appears on page* 192.]

Sir John Hunter, chairman of Sir William Arrol & Company, Limited, in a letter printed in "The Times" recently, complains of "the slow progress which has been made by the Steelmakers' Committee for the reorganisation of the iron and steel producing industry," and asserts that this is giving cause for "serious apprehension, especially as this matter had been before the steelmakers for a good number of years before Sir George May went into the matter." He recalls that Sir George made it plain that the import duties imposed on iron and steel were in the nature of a breathing space to give the steelmakers the opportunity of reorganising their production programme, and goes on to say that it is some months now that Sir George called upon the iron and steel manufacturers to put forward this programme for the reorganisation of the industry to cheapen production so that they could supply structural engineers and shipbuilders at prices which would compare with normal foreign competition and stimulate the demand for British steel. Calling attention to the work of the Iron and Steel Department of the Ministry of Munitions during the war, when a bigger production of iron and steel was urgently required by the Navy and Army and the merchant shipbuilder, Sir John says that an equal urgency exists to-day for other reasons, namely, the cost to the country the closed steelworks have created and the misery the men and their families are enduring.

Dursley Revisited.—At the suggestion of the Secretary of the Electrical Contractors' Association, Messrs. R. A. Lister & Company, of Dursley (Glos.), arranged another visit from members of the Association to their works at Dursley this week. Very great interest was aroused by the visit of the Southern Branch of the Association last month, and many who were unable to take part in the visit expressed the wish to be given another opportunity of visiting them.

Personal.

Mr. John Davison, general manager of the Barrow Hematite Steel Company, Limited, has recently been appointed a director of that company.

Mr. Frank Oxspring, who has been on the staff of the Stocksbridge steelworks of Messrs. Samuel Fox & Company, Limited, for the past 21 years, for some time as chief of the purchasing department, received a presentation from the staff on leaving the firm.

Mr. H. R. Murray-Philipson, who was returned to Parliament at the Twickenham by-election on September 16, is chairman of the North Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne, and a director of the Manvers Main Collieries, Limited, Rotherham. He is 30 years of age.

Wills.

Storey, W. J. P., of Droitwich, retired ironmaster £103,062

Obituary.

Mr. Alexander Brodie, director and secretary of the Linthorpe-Dinsdale Smelting Company, Limited, Middlesbrough, died last week, at the age of 63. A native of Inverness, Mr. Brodie was appointed secretary of the Dinsdale Smelting Company about 30 years ago. When this company amalgamated with the Linthorpe Ironworks to form the Linthorpe-Dinsdale Company, Mr. Brodie became joint secretary of the firm with Mr. J. T. Williams, who died recently. He was appointed a director about eight years ago.

New Companies.

Edward Bibb & Sons, Limited, 157, Moseley Road, Birmingham.—Capital £6,000. Brassfounders.

Algerian Iron Ore, Limited.—Capital £500. Solicitors: Reynolds, Sons & Gorst, 7, Arundel Street, London, W.C.

G. C. Pillinger & Company, Limited, 53, Victoria Street, London, S.W.—Capital £15,000. Metal manufacturers. Director: G. C. Pillinger.

E. R. Colwell, Limited.—Capital £1,000. Machinery merchants. Directors: E. R. Colwell, 1, Balfour Terrace, Middlesbrough; and Mrs. Nora Colwell.

F. Winkworth & Company, Limited, 65, High Street, Staines, Middlesex.—Capital £500. Ironfounders. Directors: F. W. H. and Dorothy Winkworth.

Steel Barrel Company (of Uxbridge), Limited.—Capital £30,000. Directors: H. R. H. Barrs; J. G. Scott, 10, Rosenthal Road, Catford, S.E.; R. P. England.

T. Carter, Sons & Company, Limited.—Capital £3,000. Ironmasters. Directors: T. Carter, "Sunnyside," Halberton, Devon; H. J. W. and J. R. L. Carter.

Meta-Phronts Company, Limited.—Capital £6,000. Iron, brass and bronze founders. Solicitors: Fairchild, Greig & Company, 1, New Square, Lincoln's Inn, London, W.C.

The Scrap Metal Position.

(*Concluded from page* 187.)

metal values were so low, and it only remains for trade to follow the lead given by metal values, and a better state of affairs will exist. Based on ruling quotations, dealers and merchants would feel more inclined to sell bare, for they know there is a chance of some reaction which will enable them to cover the sale, and, in any case, there is not likely to be the acute shortage of old metals, for there will be more encouragement for shipbreakers and others to "prepare" scrap for the consuming trades. From the user's point of view, margins between the new metal values and the prices at which scrap could be purchased have been very unfavourable, if due allowance be made for loss in melting, etc., but all this should now be altered, and the foundries would be well advised to see that an adequate saving on a purchase of new metal can be seen.

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Raw Material Markets.

Conditions remain favourable in the iron and steel markets. Although forward buying in any quantity has yet to develop, the volume of immediate business continues to increase, though slowly. An encouraging number of inquiries is being received from overseas markets, evidence that the demand is once more beginning to move. Prices of Continental material continue to stiffen.

Pig-Iron.

MIDDLESBROUGH.—There has been a temporary lull in business, as many local consumers have recently covered their immediate requirements, but they should shortly be on the market again. Overseas business continues to expand, several sales having been made to Dutch consumers, while inquiries from Belgium are in circulation. The fixed minimum prices to local consumers are: No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

More activity is being witnessed in East Coast hematite, chiefly with regard to early delivery. Mixed numbers are barely maintained at 60s. per ton, owing to the heavy holdings of merchants and producers, but there is always the possibility of an increase, as this price is well below the cost of production. On the West Coast, Bessemer mixed numbers are in good supply at 66s. per ton at works.

LANCASHIRE.—The settlement of the dispute in the cotton industry contributed to the rather more hopeful atmosphere on the iron and steel market. Actual orders are still rather slow in coming in, however, in spite of the increased inquiries. Activity in the consuming industries still remains poor, while there is no falling-off in the supplies of scrap coming into this district. Pig-iron prices are steady at 67s. per ton, delivered equal to Manchester, for Staffordshire, Derbyshire and North-East Coast iron, 65s. 6d. for Northamptonshire, 62s. for Derbyshire forge, around 84s. for Scottish iron, about 81s. for West Coast hematite, and from 67s. to 74s. per ton, according to brand, for Indian iron.

MIDLANDS.—While showing a slight improvement, the demand for foundry iron is well below the output of the furnaces, where considerable stocks are held. Some business is being done with the light-castings foundries, but there is still no improvement in the situation of the heavy engineering industries. Prices are without change, the controlled figures being 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3, delivered to Birmingham and Black Country stations. The price for No. 3 Cleveland delivered this area is the same as Derbyshire No. 3, namely, 66s. delivered, but there is no great call for this iron.

SCOTLAND.—The foundries in this area continue to be largely inactive, with the consequence that the demand for iron is still at its lowest levels. The price of 67s. 6d. per ton basis for No. 3 Scottish foundry iron remains in force, with 2s. 6d. extra for No. 1. There is still only one furnace operating, with no hope of any early increase in production. Middlesbrough No. 3 is still obtainable at the special price for Scotland of 55s. 6d. f.o.t. Falkirk, but only limited tonnages are coming forward. Midland iron continues to compete successfully with Middlesbrough iron and is being offered at around 54s. at Falkirk, but here again sales are small.

Coke.

There has been little activity in the foundry coke market, the sole feature being a slight increase in early buying. Reports show little sign of any forward buying as yet. Best Durham coke is offered at between 36s. 9d. and 38s., delivered Birmingham and district, with other qualities at down to 34s. per ton, while Welsh coke varies to a considerable extent, according to quality, at from 30s. to 45s., also at Birmingham.

Steel.

The recent activity in the steel markets has died down somewhat, but a steady volume of trade is passing, and practically all increases in prices have been maintained. Overseas markets also are showing more interest in business than for some time, but difficulties relating to exchange are holding up a considerable amount of business. Business in semi-finished steel is showing more life. Now that the difference between the prices of British and Continental steel has been reduced by the advance in the price of the latter, a considerable amount of business is being placed with British works, so that this department of the steel industry is better off for orders than for a long time. In the finished-steel department, irregular conditions still rule, and while some branches of the industry are almost neglected, the demand in others is reaching more satisfactory proportions. Inquiry from overseas, particularly from the Far East, has also become more active. The absence of any important demand from the shipbuilding industry, however, continues to be severely felt.

Scrap.

Prices of scrap iron in the Cleveland market show no increase, buying being only on a very moderate scale. There is a slightly better demand in the Midlands, but supplies are plentiful at unaltered prices. In Scotland, cast-iron scrap has weakened slightly to about 39s. to 40s. per ton. In South Wales, heavy supplies of material are on offer at recent levels.

Metals.

Copper.—The market has shown an erratic course during the week, and appears to be unduly moved by the situation on Wall Street. At all events, there are ample supplies to meet any demand, and most of the mines are now working at only about 50 per cent. capacity. The majority of producers are quoting electrolytic copper at 6.25 cents c.i.f. Europe, but supplies have been bought at 6.17½ cents. The market appears to be about stabilised at the higher level, a fact which militates against forward purchasing on the part of consumers. Should the Ottawa agreement be ratified, whereby Great Britain imposes a duty of 2d. per lb. on foreign copper, the South African and Canadian mines will be considerably increasing their output, while there is likely to be sharp competition among other producers in the effort to maintain their sales.

Closing quotations :—

Cash.—Thursday, £35 13s. 9d. to £35 16s. 3d.; Friday, £35 2s. 6d. to £35 3s. 9d.; Monday, £35 7s. 6d. to £35 10s.; Tuesday, £34 5s. to £34 7s. 6d.; Wednesday, £34 12s. 6d. to £34 13s. 9d.

Three Months. — Thursday, £35 15s. to £35 17s. 6d.; Friday, £35 2s. 6d. to £35 5s.; Monday, £35 8s. 9d. to £35 10s.; Tuesday, £34 7s. 6d. to £34 8s. 9d.; Wednesday, £34 13s. 9d. to £34 15s.

Tin.—Encouraging reports continue to be received from tinplate producers, who seem to be experiencing a moderate revival in trade. Hence the market for this metal continues to maintain its strength, although experiencing setbacks from time to time owing to profit-taking on the part of speculators.

Official closing prices :—

Cash.—Thursday, £154 7s. 6d. to £154 10s.; Friday, £153 15s. to £154; Monday, £153 2s. 6d. to £153 7s. 6d.; Tuesday, £151 10s. to £151 12s. 6d.; Wednesday, £153 10s. to £153 12s. 6d.

Three Months.—Thursday, £156 2s. 6d. to £156 5s.; Friday, £155 10s. to £155 15s.; Monday, £154 17s. 6d. to £155; Tuesday, £152 12s. 6d. to £152 15s.; Wednesday, £155 to £155 2s. 6d.

Spelter.—The demand from users has been rather limited, but the market is supported by reports of the continued reduction in stocks under the output-curtailment scheme. The fact that the galvanisers have been able to agree on an increase in the price of sheets is also regarded as an encouraging factor.

Daily fluctuations :—

Ordinary. — Thursday, £15 15s.; Friday, £15 11s. 3d.; Monday, £15 11s. 3d.; Tuesday, £15 1s. 3d.; Wednesday, £15 6s. 3d.

Lead.—The consumptive demand for this metal remains steady, following the recent period of buying. The latter, however, considerably helped to reduce the stocks held in this country, while, should trade show further expansion, consumers should be back again in the market at an early date. Plentiful supplies of Empire lead are available, and only a small premium is being asked.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £13 6s. 3d.; Friday, £12 17s. 6d.; Monday, £13 2s. 6d.; Tuesday, £12 13s. 9d.; Wednesday, £12 18s. 9d.

Continental Steel Cartel.

Prospects of Reconstitution.

During the past few weeks there have been reports that the Belgian steelmakers, or at least those works which are either opposed to the Cartel altogether, or demand a tonnage in the total Belgian share to which the other Belgian works are unable to agree, were displaying a more conciliatory attitude towards the scheme for the reorganisation of the Cartel. When prices fell to such a level that steel bars were quoted at as low as £2 1s. (gold), f.o.b. Antwerp, the idea began to prevail that the works would at last give way to the requirements of the Cartel, and even in circles closely connected with the direction of the Cartel it was thought that the organisation would be reconstituted in the course of a few weeks.

It would seem, however, that these suppositions have been premature. It is still uncertain whether the Belgian works will be able to settle their differences. In this connection our French contemporary, "L'Usine," states that it should not be forgotten that a considerable increase in prices of iron and steel products has taken place within the last few weeks. This increase naturally reduces the amount of the losses incurred by the dissenting Belgian works. The more conciliatory attitude of these works in the matter of the reconstitution of the Cartel may now be found to be less marked, and if the upward movement of prices is continued, uncompromising resistance may again develop.

In the case of Germany—the French journal states—producers there are not very kindly disposed towards the reconstitution of the Cartel, at least not in its old form. The German works put forward the condition that their adhesion very largely depended on the establishment of international selling comptoirs as an integral part of the Cartel. It appears that they claim to have paid a total of about 40,000,000 mks. into the Cartel equalisation fund for having exceeded their quotas during prosperous years. In this way they claim to have financed the exports of the other groups in the Cartel, permitting them to sell at low prices and eliminate German competition in foreign markets.

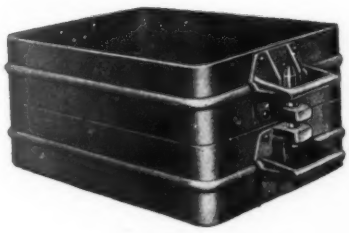
Concerning the quota convention concluded between France and Luxemburg and the German syndicates with regard to the control of the imports into Germany of French and Luxemburg iron and steel products, etc., the French journal thinks it is not strictly correct to say that the dissolution of the Continental Steel Cartel has undermined the legal basis of this convention, as it was entered into a little after the formation of the Cartel, although it is true that it would not have been brought into existence without the Cartel. It is possible that there is some idea of remodelling the convention, but there would be no desire to dissolve it entirely. In the meantime the convention continues in force.

Imports from Belgium into France have been made subject to a quota, while they remain more or less free between Belgium and Germany (being merely subject to import duties), as the territorial protection agreement became a dead letter after the dissolution of the Cartel at the beginning of 1931. Nevertheless, this protection has been given for months past in the form of official quota measures.

Despite all the difficulties, the French journal considers that the day does not seem far distant when the negotiations will be resumed in regard to an agreement in the Belgian group in the first place, and next in the matter of the reconstitution of the Cartel proper.

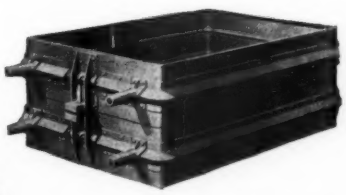
Steel Surfaces can be prevented from rusting by coating them with molten paraffin wax.

College of Technology, Manchester.—The University of Manchester has issued a prospectus of the courses in the municipal college of technology for the Session 1932-33. Copies may be obtained from the Principal of the College.



Sterling

UP-TO-DATE MOULDING BOX EQUIPMENT.



STERLING
ROLLED STEEL
MOULDING BOXES
have been designed for THE MODERN FOUNDRY.

They are light and easy to handle.
Cannot crack or break.
Cannot spring.
Strong, Rigid, Durable and Permanently accurate.

BY ADOPTING STERLING BOXES IN YOUR FOUNDRY,

You will halve your moulding costs. You will increase production per man per hour, and reduce your box maintenance costs. You will turn out more accurate castings and thereby reduce your scrap and reject accounts. You will considerably reduce your fettling costs and put money into your pocket that is now running to waste.

STERLING BOXES save their cost in a few months and are obviously a sound investment for any foundry.

STERLING FOUNDRY SPECIALTIES Ltd.

Agents at:—London, Manchester, Newcastle-on-Tyne and Glasgow.

BEDFORD.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	34 12 6
Three months	34 13 9
Electrolytic	38 10 0
Tough	36 0 0
Best selected	36 10 0
Sheets	68 0 0
India	46 10 0
Wire bars	39 0 0
Do., Nov.	39 5 0
Do., Dec.	39 10 0
Ingot bars	39 0 0
H.C. wire rods	41 0 0
Off. av. cash, August	31 9 $11\frac{9}{24}$
Do., 3 mths., August	31 6 $8\frac{35}{96}$
Do., Sttlmnt., August	31 8 $11\frac{5}{12}$
Do., Electro, August	35 2 $4\frac{7}{12}$
Do., B.S., August	33 15 $3\frac{1}{3}$
Do., wire bars, August	35 9 $1\frac{1}{12}$
Solid drawn tubes	10½d.
Brazed tubes	10½d.
Wire	7d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£ s. d.
Standard cash	153 10 0
Three months	155 0 0
English	155 5 0
Bars	155 5 0
Straits	157 5 0
Australian	155 10 0
Eastern	158 5 0
Banca	158 10 0
Off. av. cash, August	142 2 $4\frac{7}{12}$
Do., 3 mths., August	143 12 $3\frac{1}{24}$
Do., Sttlmt., August	142 1 $1\frac{7}{12}$

SPELTER.

	£ s. d.
Ordinary	15 6 3
Remelted	14 17 6
Hard	12 15 0
Electro 99.9	17 10 0
English	16 0 0
India	14 10 0
Zinc dust	22 0 0
Zinc ashes	2 5 0
Off. aver., August	13 14 4½
Aver. spot, August	13 11 $10\frac{1}{2}$

LEAD.

	£ s. d.
Soft foreign ppt.	12 13 9
Empire	13 5 0
English	14 15 0
Off. average, August	11 9 4½
Average spot, August	11 6 $11\frac{19}{24}$

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 10 0
Do., V.M. ex-whse.	22 10 0
Rods	27 0 0
Boiler plates	23 0 0
Battery plates	—

ANTIMONY.

	£ s. d.
English	35 0 0 to 42 10 0
Chinese	25 0 0
Crude	16 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	9 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	8 0 0
45/50%	13 15 0
75%	19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10½d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£25 15 0
6/8% car.	£24 10 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£37 5 0
Max. 1% car.	£44 10 0
Max. 0.70% car.	£45 17 6
70%, carbon-free	1/- lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4½ lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	1 18 0	to 1 19 0
Bundled steel and shrngs.	1 15 0	to 1 18 0
Mixed iron and steel	1 15 0	to 1 16 0
Heavy cast iron	2 1 0	to 2 2 6
Good machinery	2 5 0	to 2 7 6
Cleveland—		
Heavy steel	1 12 6	to 1 15 0
Steel turnings		1 7 6
Cast-iron borings		1 2 6
Heavy forge		2 10 0
W.I. piling scrap		2 2 6
Cast-iron scrap	1 15 0	to 1 16 0
Midlands—		
Light cast-iron scrap		1 15 6
Heavy wrought iron		2 0 0
Steel turnings, f.o.r.		0 19 0
Scotland—		
Heavy steel		1 13 0
Ordinary cast iron		1 19 6
Engineers' turnings		1 7 6
Cast-iron borings		1 10 0
Wrought-iron piling		2 0 0
Heavy machinery		2 5 6

London—Merchants' buying prices delivered yard.

Copper (clean)	26 0 0
Brass	19 0 0
Lead (less usual draft)	11 10 0
Tea lead	10 0 0
Zinc	8 10 0
New aluminium cuttings	72 0 0
Braziery copper	23 0 0
Gunmetal	20 0 0
Hollow pewter	82 0 0
Shaped black pewte	65 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	60/6
Hematite M/Nos.	60/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	70/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—
Scotland—	
Foundry No. 1	70/-
No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/-
Clyde, No. 3	84/-
Monkland, No. 3	84/-
Summerlee, No. 3	84/-
Eglinton, No. 3	84/-
Gartsherrie, No. 3	84/-
Shotts, No. 3	84/-

*d/d Black Country dist.

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 5 0	to 9 15 0
Nut and bolt iron	7 15 0	to 8 10 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ¾ in. × 4 in.	12 0 0	
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 7 6	to 9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ¾ in. (Untested)	6 12 6	& up.
Flats—8 in. wide and over		8 12 6
under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0	to 8 10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0	to 8 10 0
Galv. cor. shts.		10 0 0
Galv. flat shts.	10 10 0	to 11 0 0
Galv. fencing wire, 8g. plain		12 15 0
Billets, soft	4 17 6	to 5 7 6
Billets, hard		6 12 6
Sheet bars	4 15 0	to 5 5 0
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12d.
Rods	10½d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
furnace	16/- to 17/-
Durham and Northumberland—	
foundry	21/- to 25/-
furnace	12/- to 12/6
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/-
"	28×20 "	32/-
"	20×10 "	23/6
"	18¾×14 "	16/3
C.W.	20×14 "	13/- to 13/3
"	28×20 "	—
"	20×10 "	—
"	18¾×14 "	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Sept. 22 ..		35	13	9	inc.	18/9
,, 23 ..		35	2	6	dec.	11/3
,, 26 ..		35	7	6	inc.	5/–
,, 27 ..		34	5	0	dec.	22/6
,, 28 ..		34	12	6	inc.	7/6

Electrolytic Copper.

		£	s.	d.		
Sept. 22 ..		39	5	0	inc.	25/–
,, 23 ..		39	0	0	dec.	5/–
,, 26 ..		39	0	0	No change	
,, 27 ..		38	10	0	dec.	10/–
,, 28 ..		38	10	0	No change	

Standard Tin (cash).

		£	s.	d.		
Sept. 22 ..		154	7	6	inc.	52/6
,, 23 ..		153	15	0	dec.	12/6
,, 26 ..		153	2	6	,,	12/6
,, 27 ..		151	10	0	,,	32/6
,, 28 ..		153	10	0	inc.	40/–

Tin (English ingots).

		£	s.	d.		
Sept. 22 ..		156	5	0	inc.	50/–
,, 23 ..		155	10	0	dec.	15/–
,, 26 ..		155	0	0	,,	10/–
,, 27 ..		153	5	0	,,	35/–
,, 28 ..		155	5	0	inc.	40/–

Spelter (ordinary).

		£	s.	d.		
Sept. 22 ..		15	15	0	inc.	7/6
,, 23 ..		15	11	3	dec.	3/9
,, 26 ..		15	11	3	No change	
,, 27 ..		15	1	3	dec.	10/–
,, 28 ..		15	6	3	inc.	5/–

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Sept. 22 ..		18	0	0	inc.	10/–
,, 23 ..		17	15	0	dec.	5/–
,, 26 ..		17	15	0	No change	
,, 27 ..		17	7	6	dec.	7/6
,, 28 ..		17	10	0	inc.	2/6

Zinc Sheets (English).

		£	s.	d.		
Sept. 22 ..		24	10	0	No change	
,, 23 ..		24	10	0	,,	,,
,, 26 ..		24	10	0	,,	,,
,, 27 ..		24	10	0	,,	,,
,, 28 ..		24	10	0	,,	,,

Lead (English).

		£	s.	d.		
Sept. 22 ..		15	0	0	inc.	10/–
,, 23 ..		14	15	0	dec.	5/–
,, 26 ..		15	0	0	inc.	5/–
,, 27 ..		14	15	0	dec.	5/–
,, 28 ..		14	15	0	No change	

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 14 2
1903	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 13 4
1911	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 19 7½
1912	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916	26 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 3
1918	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923	18 3 1½	19 1 11½	19 8 0	19 10 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2
1924	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 9 4½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	6 15 0	16 11 0½
1926	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	6 19 0	16 10 0½
1927	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928	13 0 0½	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929	13 11 0	13 13 1½	13 12 9½	13 10 11½	13 9 3	13 8 9	13 11 6	13 7 6	13 7 6	13 5 6	12 18 9	12 12 9½	13 7 5½
1930	12 5 0	11 15 0	11 19 6	11 18 7	11 18 0	11 17 6	11 17 6	11 17 6	11 16 3	11 12 6	11 8 9	11 5 0	11 15 11½
1931	11 4 0	11 0 0	11 0 0	11 0 0	10 13 9	9 18 9	9 13 0	9 5 3½	8 19 0½	9 16 0	9 8 9	9 4 0½	10 1 10½
1932	9 2 9	9 14 4½	9 16 0	9 13 9	9 12 6	9 12 6	9 11 0	9 4 4½	9 12 3	—	—	—	—

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